

The ROSE X.25 Packet Switch

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Abstract

The ROSE X.25 Packet Switch is the product of many years of effort and experience in the data communications market. The design goal was to provide a state of the art networking device that could clearly be used as a building block in the creation of a global amateur data network. The switch is a very reliable and efficient alternative for amateur packet radio networking. There are currently at least fifty (50) switches in operation throughout the world. It is felt by many groups that it is the best solution for amateur packet networking.

Introduction

The ROSE X.25 Packet Switch is an advanced replacement for the common digipeater or other node switching EPROM. The ROSE Switch represents the state of the art in packet switching technology using international standard protocols. It is based on the CCITT X.25 Network Layer, and the ARRL AX.25 Link Layer Protocols.

The ROSE X.25 Packet Switch is the best solution for Amateur Packet Radio Networking. A ROSE Switch can be accessed by standard AX.25 TNCs supporting the AX.25 Link Layer protocol. The AX.25 Link Layer protocol is also used on paths between backbone switches. The X.25 Network Layer protocol is used by the switches to transfer the users' data through the network. See the ROSE X.25 Packet Switch Users Manual for a complete list of features.

Addressing

The ROSE X.25 Packet Switch supports the global addressing plan adopted by CCITT and ISO. This plan includes a country code and a national network number. The ROSE Switch follows the numbering plan in use in the national X.25 packet switching network, most packet networks follow the telephone numbering plan used in that country. North America uses the telephone Area Code and Exchange.

This system will allow a user to request a connection with another station without any concern given to the exact path the data will follow. This is in sharp contrast to the explicitly specified approach used by digipeaters. The motivation for this is that the general user population doesn't care to, or have time to, keep abreast of the networking changes over time. The routing is under your complete control, so users can't clog the network with retries on obsolete RF paths. Users only need to know the Network Address of the destination, which is like a telephone number.

The ROSE Switch may be configured with several paths to remote Area Codes or countries. Each of the specified links will be tried in the order they were specified to find an operational route. This is an improvement on several existing amateur

systems which can only provide implicit destination routing to switches known by the source switch.

The telephone exchanges are allocated based on the population density of each area. A single ROSE X.25 Switch can provide RF coverage of many different exchanges. A full list of exchanges that the switch should handle as its own can be specified.

The addressing also needs to support routing to different countries, the X.121 standard handles this with a prefix country code. In data networks the country code is called the Data Network Identification Code (DNIC), the ROSE Switch supports up to 8 different DNICS, and will be expanded as the networks grow. The user can specify the DNIC in the TNC connect command by adding an extra four digit digipeater field between the switch callsign and the network address, for example to connect to VE7APU in Canada you could enter the following command:

```
C VE7APU V N2DSY-3,3020,617385
```

The ROSE Switch would see the four digit group and the fact that another digit field followed it and merge the numbers, resulting in an address of 3020617385.

If you get a call from a station that is in a different DNIC than the ROSE Switch you use, it will insert the correct DNIC in the digipeater field preceding the network address in the connect request. This insures that you know how to reach the user at a later date, as well as providing identification of **international** contacts which sometimes require special considerations by the users in the contact.

Routing

The ROSE X.25 Packet Switch supports a very flexible static routing scheme. The routing is static in that the the routing tables are not automatically updated in any way. The normal method of having automatically updated tables is through the use of various broadcasts for routing updates, ROSE does not do this. Instead the system manager should configure the switch with all the reasonable paths for a given address. This avoids the problem of short band openings that provide routing information but no useful data transfer.

When attempting to route a call request the switch will obtain the alternative list for the address specified from the routing table. The list contains a sequence of which local switches can handle the call in order of the preference of the path.

The most preferred switch that is not listed as "Out of Order" will be sent the call request. If that switch responds with a network level error, such as "No Path" or "Out of Order" the next path in the alternative list will be tried. If it runs out of alternatives the call will be cleared with a cause of "Out of Order".

A switch will mark a local switch as "Out of Order" if it can not establish network level communications with the switch. The switch will be considered as "Out of Order" for a configurable period of time.

A routing loop can occur when a switch receives a call request that it has already routed to another switch. This is detected by the switch by examining the following information from the call request packet; Source Network Address, Source Call Sign, Destination Call Sign and a random number.

The random number is comprised of an 8 bit call sequence number and an 8 bit random number. The call sequence number is incremented for each new call request a switch handles. If a loop is detected the second call request is cleared with a network level error and the preceding switch will then try the next alternative.

Network Definition

Designing local network topology can be an art in itself. The following is a good template that can be used to determine a first best guess as to how the various paths should be used. Once you have a network operational you should try various paths to optimize the traffic flow. In many cases gut feelings should be tried as there are things we all know about RF paths that I haven't been able to put into words.

In order to define a network of ROSE X.25 Packet Switches, perform the following steps:

1) Draw a network layout consisting of switches and the usable RF paths between each adjacent switch.

2) Assign each switch a **callsign** and address consisting of the telephone Area Code and Exchange of the location of the switch.

3) Prioritize the reliability of each switch's outbound links. Preferred paths should have many of the following characteristics; Solid paths, low volume paths; high speed channels; and low contention. In general the number of emitters on a given frequency should be kept low. Hidden transmitters should be eliminated. All the emitters should hear each other well enough to cause the carrier to be detected by the modem. The shortest path between two points is the path with the most available band width, not the shortest distance!

4) For each link list the switches within your network that can be reached. If a switch shows up more than once decide the order that they should be used, usually "shortest" to "longest". Inter-switch traffic on a user channel should be avoided.

5) Next decide the best path for traffic from switches outside your control should follow. These can be thought of general directions, such as North, South, etc. Usually the inter-LAN boundary is obvious, all you have to do is decide what route through your switches you want this foreign traffic to follow. This route is a good candidate for a backbone channel on a different band.

When each of these items is defined, you will have completed a basic network design. The method is minimal, but it will assist you in understanding the workings of the network when you start the deployment phase. It will also be helpful when trying to debug network problems.

Network Configuration

In a ROSE X.25 Network each switch has a description of what the network looks like from its point of view. This consists of a list of switches that it talks to directly and routing information. The routing information describes what network addresses each of the switches in the list can handle. When a connect request is received by a switch it must be able to decide where the request should be sent next. Connection requests can be from either a local user or from another switch.

The configuration of a switch is stored in a file that contains four sections. These are:

- 1) Default Parameters
- 2) Information about the switch being configured
- 3) A list of switches local to the switch being configured
- 4) Routing information, who should handle what addresses

Default Parameters

There are four switch parameters that can be defaulted, the form of the default command is:

DEFAULT par Value

Where the "par" is one of the following and the value is as described.

L3W 1.7

This configures the Level 3 Packet Window, much like **MAXFRAME** for TNC Links. As noted valid values are 1 through 7.

Timeout **0.65535**

When a network Link is not operational due to a radio failure or interference a timer is started to keep the switch from continuously trying to bring up the link. This is done to reduce the time required to route around a malfunctioning switch or path. The suggested value is 900 seconds (15 Minutes), but other values can be used from 0 to 65535 seconds (18 Hours). A realistic minimum value is **3-5** minutes. A lower value could cause the call router to try a bad link more than once with the same call request.

MaxVC 0.254

This parameter sets the number of **VCs**, or simultaneous connections, that will be allowed on a Link to another switch. The recommended value for this is 20. A special case occurs when this statement appears in a **USER** block statement.

Port **0.4**

This defines which serial port on the switch the Node or User is said to be listening. On a TNC-2 the radio is Port 0 and the RS-232 connector is Port 1.

The recommended values for these defaults are:

```
DEFAULT PORT 0
DEFAULT TIMEOUT 900
DEFAULT L3W 4
DEFAULT MAXVC 20
```

Include

This default parameter defines a directory that the configuration program will check for include files (*<). This directory is only checked if the included file is not found in the current directory.

```
DEFAULT Include C:\ROSENET\
```

Information about the switch being configured

The first thing that must be done is a declaration of what country this switch is in. This is done with the DNIC command, which has the form:

```
THIS DNIC 3100 United States of America
```

The THIS command is used on the beginning of a statement to identify that the rest of the line is for the switch that is being configured.

The 3100 is the country code for the USA within the data networks. A complete list of DNICs can be found in the ROSE X.25 Packet Switch Users Manual.

Once this is done you can define the internal information about the switch being configured. Again we use the THIS prefix to identify we are talking about the switch being configured.

```
THIS NODE Clifton
```

The NODE statement is a Block Statement that is terminated with an END statement.

Note: The location name, Clifton in this case, is only used within the configuration file, not on the air.

Each switch must have a Network Address, this is what is used to reference the switch as the destination of a Call Request from anywhere in the network.

```
ADDRESS 201478
```

The address can be from 1 to 6 digits long and must follow the national numbering plan in use for the X.25 network. In the United States of America this must be the Area Code and local Exchange of the location of the switch.

In order for users and other switches to establish Links to this switch it must have an Amateur callsign.

```
CALL W2VY-3
```

CALL is short for CALLSIGN in this case. The EPROM default for the callsign is ROSE-3.

Each switch also has a **callsign** that can be used for digipeating, this may be the same as the **CALL**. The default digipeat **callsign** is ROSE-2. If the **CALL** and **DIGI** are the same they both still need to be specified.

DIG1 W2VY-2

If a switch has a RF coverage that crosses more than one telephone exchange then these extra exchanges can be specified in the **COVERAGE** statement. This is a Block Statement and is terminated with an **END**. This is an example of a nested block statement, we are still in the "This Node Clifton" Block.

```
COVERAGE
^ 201472 201473 201777 201779 201470 201478
  201778 201772
END
```

Each of the Network Addresses listed above will be treated as if they were the switch Network Address, 201478 in this case.

When a Call Request is received that has this switch as the destination, address 201478 or one in the Coverage list, the switch will attempt to establish a Link with the specified user. If the switch is running on multi-port hardware, such as a PacComm DR-200 there are times when you need to specify which Port the users are resident on. The **USERPORT** statement specifies which Port should be used to establish Links to users. On a TNC-2 the Radio port is port 0. On a PacComm DR-100 the radio port is port 1.

USERPORT 0

A user can connect to the switch and get information about how to use the network, or other information of general interest. This is specified in a **TEXT** block, which is ended with **"\$EOF"**. A blank line is inserted by having a **"\$"** on a line by itself.

TEXT

\$

While Disconnected From THIS X.25 Switch issue a command like:

\$

C CALLSIGN-SSID V W2VY-3,201256

\$

Switches Available for User Access are:

Address	Callsign	Location	User Port Freq
201256	W2VY-3	Montclair	221.11 Mhz
201744	N2DSY-3	LittleFalls,NJ	145.07 Mhz
609426	KA2VLP-3	Hightstown,NJ	145.07 Mhz
609261	WA3YRI-3	MtHolly,NJ	145.07 Mhz
212456	KD6TH-6	Manhattan,NY	145.07 Mhz
609530	N2EVW-9	Ewing,NJ	221.01 Mhz
609883	N2EVW-8	Trenton,NJ	221.11 Mhz
201663	N2ELC-3	Lake Hopatcong,NJ	145.09 Mhz

\$

Possible connect paths available to access BBS User ports.

C KB1BD-4 v W2VY-3,609426 : C WA2VXT-4 v W2VY-3,609426

C KD6TH-4 v W2VY-3,201744 : C N2ELC-4 v W2VY-3,201663

\$

Connect Paths Available to KA-Nodes or TheNET Facilities:
C WB2DRD-3 V W2VY-3,609426 : C WB2MNF-3 V W2VY-3,609530

\$
When connecting to TheNet Nodes act as if you have connected direct to it. Type C NODENAME, after you have connected to either of the TheNet nodes listed above, to connect to the next desired node. Type NODES to get a node list after your connect or type Info to get information about the particular TheNet node you are connected to. Example: To connect to ELK TheNet node use the following sequence:
C WB2DRD-3 V W2VY-3,609530

C ELK

\$
You will shortly be Disconnected from this switch. If you are currently connected via either TheNET or KA-Node RECONNECT to THAT node and then issue a connect as shown above. Note: It has come to our attention that those systems using old TNC1 code will not accept all digit fields, substitute o for 0 and i for 1 in the all digit field and you will be successful. Disconnect codes can be found on the KB1BD-4 PBBS, filename is DISCO.COD. Please address questions to KB1BD@KB1BD or W2VY@KD6TH. This switch brought to you courtesy of RATS. Enjoy 73 Tom W2VY
\$EOF

This connect TEXT can be up to 2048 bytes long.

To terminate the definition of the Clifton Node the END statement is used, completing the block statement.

END

Local Switches

The next section describes the switches that this switch communicates with directly.

NODE Manhattan
ADDRESS 212456
PATH KD6TH-3
END

This defines a local switch that has the **callsign KD6TH-3** and network address 212456 and is located in Manhattan. Based on the current defaults it is also on PORT 0 with a link timeout of 15 Minutes and can support up to 20 calls. Each call will operate with a level 3 packet window of 4.

For the purposes of this description we will also define three other local switches.

NODE LittleFalls
ADDRESS 201744
PATH N2DSY-3
END

```
NODE Clif ton2
ADDRESS 201779
PATH W2VY-9
PORT 1
END
```

```
NODE Montclair
ADDRESS 201256
PATH W2VY-12 Via KB1BD-2
END
```

Each of these are pretty standard with the following exceptions. Clifton2 is on PORT 1, which would be the asynchronous port if we are running on a TNC-2 and that port could be connected to either a modem and radio or a back to back cable to another TNC. Montclair has a digipeater specified, the path to a switch can include up to ONE digipeater.

If you have a special device that is not on the USERPORT channel you can configure it in the switch as a USER. If this USER is not an X.25 Pad (ie it's a TNC or TheNet/NetROM) you must specify MAXVC 0.

```
USER KD6THbbs
PATH KD6TH-4
PORT 1
MAXVC 0
END
```

If a call came in for **KD6TH-4** with a switch address of 201478 the switch would attempt to establish the link on Port 1, as was specified. This can be done for any **AX25L2** device, such as a **TheNet** or **NetROM**, as well as a **BBS**. Users are not encouraged to be placed on the backbone. If using a TNC-2 you would just specify the address of the switch that had the radio port on the backbone. This feature is used mostly when the switch is running a **PacComm DR-200**, or other multi-port synchronous device.

Routing Information

The route statements specify what local switches should be given calls for which network addresses. This is usually divided into two parts, first specifying the routing needed for the switches within the local network (the switches you control) and the second specifying the routing for out of area network addresses.

The general form of the ROUTE statement is:

```
ROUTE TO NODES node-list
CALLS FOR
network-address-list
END
```

Where "node-list" is a sequence of switches; and "network-address-list" is a list of Network Addresses. If a Call Request is received for one of the addresses in the list the switch will use this routing information to pass the Call to the next switch. The switches are tried in the order they are listed, so the best route should be listed first, worse last. It has been done this way because by and large there are a limited number

of ways to get from this switch to a remote region. From the Clifton switch I can route calls for New England to Manhattan or Little Falls, so the following statement would set up the required routing entries.

```
Route to Nodes Manhattan LittleFalls
Calls for
207 802 617 508 413 203 401
518 607 212 718 716 516 914 315
end
```

I also included the Area Codes for New York.

We also need to include the routes for the local switches. The routing information here should include the address of each switch as well as the addresses in it's coverage.

```
Route to Node Manhattan
Calls for
212456
end
```

```
Route to Node LittleFalls
Calls for
201744
end
```

As well as addresses to the south and west:

```
Route to Node LittleFalls
Calls for
609 215 717 202
end
```

There are files included with the distribution diskette that have the Area Codes for the entire USA, broken down by state and call district, see NPA.ARC. These files can be placed in a separate directory and included in the configuration with the *< command.

Now that we have defined the configuration of a switch we need to create, and save to disk, the file that the switch can understand. The WRITE statement is used to create this file.

```
WRITE w2vy-3.tbl
```

The file naming conventions that we use here in NJ are the statements that were used in the example are stored in a file with the name CallSign.CNF and the output is stored in the file CallSign.TBL. ("CNF" Configuration; ".TBL" Table)

The last statement of each .CNF file should be a QUIT to tell the configuration program to terminate and return to the operating system.

Additional Configuration Commands

If you are having problems figuring out an error, it can be helpful to see the commands that the program is reading. You can cause the configuration program to print each statement as it reads it in by including a `VERIFY` statement.

```
VERIFY
... statements causing problems...
NOVERIFY
```

The `NOVERIFY` statement turns this feature off, there can be any number of `VERIFY/NOVERIFY` statements in a configuration file.

Special Characters to the Configuration Program

Any line in the configuration file (.CNF) that starts with an asterisk (*) is treated as a comment, which can be useful to indicate extra information about a switch, such as equipment at the location, access rules, failure history, etc.

There is one exception, if a line starts with "`*<`" the configuration program will treat the text on the rest of the line as a file name. The program will expect the file to be in the current directory or the directory specified in the Default Include statement. The contents of the file will be read in as if it had been in the main file. If the file is not found an error message will be printed.

The file that is being read in can not have another "`*<`" in it, this may be revised in later versions of the configuration program.

```
Route to Nodes Manhattan LittleFalls
Calls for
*<w1.npa
*<ny.npa
end
```

This would be the same as the previous example of routing the calls for New England and New York, using the supplied files in `NPA.ARC`.

ROSE X.25 Packet Switch Applications

A Switch Application is a special type of network destination, like a BBS is a special **callsign** that you connect to. Once connected to it you can issue commands and get replies. The following sections describe the existing applications and list any commands and example replies.

To connect to a switch application you would follow the same procedure that you would to connect to a user, but instead of entering a user's callsign you enter the name of the application. If your local switch is `W2VY-3` and you want to interact with the `MEMSIZ` application at network address 201478, you would issue the following connect command:

```
C MEMSIZ Via W2VY-3,201478
```

This is a standard ROSE X.25 Packet Switch connect request. The local switch would route the Call Request to the switch with the network address 201478. When a

switch receives a Call Request it first checks to see if the destination "callsign" matches any of the currently loaded applications. If the application is found the switch would set up connection with the application. If the application was not loaded it would assume that it was a local user and attempt a connect on the userport.

Once connected to the MEMSIZ application you would get the ROSE banner:

```
ROSE X.25 Switch Version 890820 by Thomas A. Moulton, W2VY
```

This would indicate that the connection is complete and you could start interacting with that switch.

The CONFIG and LOADER applications accept commands that are in an obscure Intel Hex like format, this will be replaced with plain language commands in the future.

LOADER Application

The LOADER application is resident in the EPROM, this means it is always present. As you may be able to guess from the name, it is used to load other programs into the switch. This will allow you to chose which switches will have what functions.

The files with the filename extension ".LOD" are files that can be sent to this application, which will cause the specific application to be loaded into memory. The file "CONFIG.LOD" when sent (ASCII/TEXT upload) to LOADER would cause the CONFIG application to be loaded into memory.

When loading a .LOD file you should get three "OK"s back, the only other message you could get would be "Error n" where N is a numeric value indicating what type of error occurred, the following table lists the possible error numbers.

<u>Error #</u>	<u>Meaning</u>
01	Invalid command
02	Invalid Object
03	Unable to allocate memory for program
04	Incorrect checksum
09	Length mismatch of code segment in .LOD file
o c	Can't delete non-existent application
OD	Need to load code segment before relocation info
OE	To many applications loaded, max is 15
OF	Unsupported object
10	Unsupported command

LOADER also supports two other commands:

```
List Applications ":0000000000"
```

This command will cause the switch to list all the applications that are currently loaded into the memory. When the switch is first powered on the list will look like this:

```
Entry #0 LOADER - Application Boot interface  
OK
```

If the switch has all the applications loaded into memory then the list might look like this:

```
Entry #0 LOADER - Application Boot interface
Entry #1 CONFIG - ROSE X.25 Packet Switch Configuration Interf...
Entry #2 USERS - ROSE Switch User List Display, Version 1.0
Entry #3 MEMSIZ - ROSE Memory Utilization Display
OK
```

The entry # is just the position in the list that the application is listed, this number is only important when you are using the Delete command.

```
Delete Application ":02ee000000"
```

This command will remove an application from memory, thus freeing the memory to be used for other things such as data buffers or additional connections. The "ee" is the entry number the application is in the list.

Lets say you want to delete the CONFIG application from a switch, first you would connect to the LOADER and then list the applications:

```
:0000000000
Entry #0 LOADER - Application Boot interface
Entry #1 CONFIG - ROSE X.25 Packet Switch Configuration Interf...
Entry #2 USERS - ROSE Switch User List Display, Version 1.0
Entry #3 MEMSIZ - ROSE Memory Utilization Display
OK
```

Notice that the CONFIG application is in entry #1 this time, you would enter the following command, replacing the "ee" with "01".

```
:0201000000
OK
```

You could then verify that it was done by entering the list command again. The "OK" does tell you that it was in fact done, but we'll check anyway, you don't have to check.

```
:0000000000
Entry #0 LOADER - Application Boot interface
Entry #1 USERS - ROSE Switch User List Display, Version 1.0
Entry #2 MEMSIZ - ROSE Memory Utilization Display
OK
```

Note that all other applications moved up in the application list.

When you are done interacting with the LOADER you just disconnect.

USERS Application

The USERS application is used to list the users that are currently using the switch; connected to a local user/bbs; passing through to another switch; or interacting with an application that has been loaded. Once you are connected just hit return to view the current status of the connections.

ROSE X.25 Switch Version 890820 by Thomas A. Moulton, W2VY
[You Press Return]

User List for N2DSY-3 3100201744

Memory Size is 29kb
Memory Used is 12kb

```
W2VY   AX25L2 User Linked to USERS   @ 3100201744
W2VY   AX25L2 User Linked to LOADER  @ 3100201744
W2VY-3 X.25 Trunk (R1) with the following connections:
KD6TH-4 @ 3100201256 ( 20 P4 DI) <-- KB1BD-5 @ 3100609443
WB2JQR-3 X.25 Trunk (R1) with the following connections:
KB1BD-5 @ 3100609443 ( 20 P4 DI) --> KD6TH-4 @ 3100201256
```

There are no calls Pending.

The Following X.25 Trunks are listed as Out of Order:
<None> - All Links Operational

The first line identifies the **callsign** and address of the switch that the display is for. This is followed by the memory usage of that switch.

The second section shows all active connections. The first connection is my station connected to the USERS application (its how I generated the above display). The second connection is my station connected to the LOADER application. Note that a connection that is listed as "AX25L2 User" is a user directly connected to that switch.

Now things start to get interesting, W2VY-3 is another ROSE X.25 Packet Switch and it has one VC. The VC is between KB1BD-5 at address 609443 and KD6TH-4 at 201256, these are two BBSs doing forwarding.

In this case neither BBS is local so the call also shows up on a second X.25 Trunk. The arrow indicates the direction that the connect request went in, ie. KB1BD-5 called KD6TH-4.

Note that this connection shows up twice, once to enter the switch and once to leave. If a user was using the switching function to connect to a station on the same switch there would be two entries listed as AX25L2 Users.

A pending call is a connect request that came in while the trunk, or link, to the required switch was not ready. A Call is left in the pending state while the Switch attempts to bring the link into the ready state (R1).

If a link to a switch is not operational then it is marked as being Out of Order for a specified time.

MEMSIZ Application

The MEMSIZ application was just a test program for me to verify correct operation of the loader. It turns out that it can be useful to monitor the amount of memory that is being used by the switch from time to time. This information is also included in the USERS application display. The values are listed in hexadecimal.

Memory Size is: 7578
Memory Used is: 4155

CONFIG Application

The CONFIG application is not designed to be used directly by the switch manager. It is just an interface that processes the file created by the Network Configuration Program (CONFIGUR.EXE). This section will describe the interface for completeness, and there may be times when you might want to check some of the settings. All replies are in hexadecimal and are not easy to interpret. As with the LOADER interface every command will generate either an "OK" or "Error n" when the processing of the command is complete, the meaning of each of the errors are as follows:

<u>Error #</u>	<u>Meaning</u>
01	Invalid command
02	Invalid Object specified
03	No working memory!
04	Bad checksum!
05	Unsupported Command
06	Odd number of data bytes for type
07	Item is Read-Only

For OD object only:

01	No working memory
02	Invalid DNIC

The CONFIG application allows modification of the following data objects within the switch:

- * The TEXT that a user can access if they connect directly to the switch and hit return.
- * The Call sign and digipeater call sign of the switch.
- * The call signs of any switches this switch communicates with.
- * The call sign and port number of any configured Users
- * Network parameters such as Maximum number of VC's, Level 3 Window.
- * The TIMEOUT value for a failed network link, ie one that is marked "Out of Order".
- * Port that the level 2 users are found on.
- * Network address of this switch.

* AX.25 level 2 parameters for user connections. (Maxframe, Paclen, Resptime, Frack, Retry)

* AX.25 level 2 parameters for X.25 Network links.

* The routing tables remote call requests.

Programming the EPROM

If you have access to an EPROM programmer you can use one of the files supplied, either the Intel HEX file ROSEZSW.HEX, or the binary image ROSEZSW.BIN. If you do not have access to a programmer you can obtain a pre-programmed EPROM from the author.

NOTE: The SAME EPROM will function in TNC-2/Clones and the PacComm DR-100/200, the initialization code checks it all out and sets up the system. A test switch will work fine with 16K, but it is recommended that a fully functional network switch is installed with 32K.

Permanent Configuration of the Switch

The distribution includes a "MAP" file that contains the EPROM address of all entry points and important variables. Using this information you can modify the default parameters in the EPROM. The format of the data falls into four forms. A byte, a word, a callsign and a network address.

A byte is simply a single location in the EPROM which can hold a value from 00 to FF (that is 0 to 255 decimal).

A word is a two byte value with the low order byte of the word stored at the lower EPROM address. A word can contain a value from 0000 to FFFF (that is 0 to 65535 decimal). Since it is stored low byte at low address the value 01 00 is 1 decimal, and 00 01 is 256 decimal, or 0100 hexadecimal.

A callsign is stored in AX.25 format, the same way it appears in packets sent over the air. Each callsign is a six byte shifted ASCII callsign followed by a single byte SSID, for example in the EPROM the callsign ROSE-3 would have the following format:

A4 9E A6 8A 40 40 06

A network address is stored in CCITT X.25 address format, which is a length byte followed by a BCD representation of the address, for example the address 3100201779 would have the following format:

OA 3100 20 17 79

Note that the length (OA, 10 decimal) is the number of BCD digits, ie "31" is two digits.

If you are outside the USA the numbering plan may use something other than six digit codes, if the length is ODD then just pad the last byte with an extra 0, but leave the length ODD. I know Australia uses a variable length numbering plan, the format for node address 50502 (which is the region code for Sydney) would be:

05 50 50 20

Note that the length is 5 (50502) and the last digit is ignored and should be 0.

The following ".MAP" file labels identify the location of the following EPROM defaults:

"myaddr" - Network address of this switch
"mycall" - Callsign of this switch
"mydigi" - Callsign this switch recognized for digipeating
"defdnic" - Default local DNIC, EPROM has USA: 04 31 00

Power ON Indications for TNC-2

The ROSE X.25 Packet Switch has a two phase initialization sequence.

In the first phase you should see the PWR, CON and STA lights come on for TWO (2) seconds while the Switch tests RAM and verifies the battery backed up RAM.

The second phase the CON and STA LEDs are used to indicate what was going on when the switch was powered off. This indication is displayed for THREE (3) seconds (they both normally stay on). If they both go out, then the switch was processing data when the power was removed. When powering a unit as a ROSE Switch for the first time, this display is meaningless.

At this point the CON and STA lights should alternately turn on and off once a second, this indicates that the switch is operating correctly.

Configuring a ROSE X.25 Packet Switch

The following example shows how to configure a switch from anywhere within the local ROSE X.25 Network.

```
cmd:c w2vy-3
*** CONNECTED to W2VY-3
[Hit Return]
ROSE X.25 Switch Version 890820 by Thomas A. Moulton, W2VY
*** DISCONNECTED
```

Since the text is not loaded, there must have been a power failure at the site, and therefore the CONFIG application needs to be reloaded.

```
cmd:c loader v w2vy-3,609426
*** CONNECTED to LOADER VIA W2VY-3,609426
ROSE X.25 Switch Version 890820 by Thomas A. Moulton, W2VY
:0000000000
Entry #0 LOADER - Application Boot interface
OK
```

The CONFIG application is NOT loaded, so now you would send the file CONFIG.LOD, it is an ASCII TEXT file.

You then get the 3 OK's and disconnect.

```
cmd:d
cmd:*** DISCONNECTED
```

```
cmd:c conf ig v w2vy-3,609426
*** CONNECTED to CONFIG VIA W2VY-3,609426
ROSE X.25 Switch Version 890820 by Thomas A. Moulton, W2VY
```

Now send the .TBL file and receive 11 OK's, when done disconnect.

```
cmd:d
cmd:*** DISCONNECTED
cmd:
```

The switch is now reconfigured.

In an operational network any switch can be loaded from any point within the network. You just need to issue a connect command to your TNC that had the **callsign** of the local switch, followed by the network address of the switch you wish to interact with.

When accessing a completely unconfigured switch remember the default **callsign** is ROSE-3 and the default address is 000000. This should only happen the first time you bring up a switch. If you notice that the switch fails to remember it's **callsign** after the power has been removed for a short time, that may indicate that the battery needs replacing. Lithium batteries are usually good for 3 Years - TAPR TNC-2's should be needing new batteries soon!

Asynchronous Communications

The ROSE X.25 Packet Switch supports the asynchronous port of a TNC-2 or Clone as just another radio port. The goal is to allow connection to any standard RS-232 device, such as a modem. The RS-232 signals operate in a normal fashion which allows connection to conventional land line modem, multiplexers or any other communications equipment that is available to provide backbone linking.

The immediate application is connection of a Bell 202 modem and a radio to provide a local backbone for a given area. This type of set up requires half as many TNC's!

Two or more switches may also be tied together on the RS-232 ports to provide multiple synchronous ports from a single site.

Asynchronous pin definitions:

All connections are to J1 (DB 25)

Pin #	Direction/EIA Pin Designation/Usage
1 [5]	NA/Frame Ground
2 [3]	In/TXD/Data On

3 [2]	Out/RXD/Data Out
5 [8]	Out/CTS/Request To Send (Async PTT)
7	NA/Ground
10	Out/LO/Pull Down signal
20	In/DTR/If LO wired Back to Back . /If not LO used as Radio Port
23 [9]	In/SEL/Carrier Detect

Note: Pin numbers in brackets are for PacComm Tiny-2 and Micropower. For Tiny and Micropower in Back-To-Back configuration also need to add jumper from U15 (MAX231) Pin 3 to U15 Pin 4.

Differences between ROSE and Net/ROM Back-to-Back Cable

The asynchronous port of a Net/ROM is not standard RS-232 signaling. In order to be able to use the diode matrix Software 2000 inverted the meaning of the Request to Send (RTS) signal.

Asynchronous Radio Port Cable

Radio Port Cable Needs:

CAPS mean TNC, lower means Modem DB25

GND PIN 1 - gnd pin 1
 TXD PIN 2 - rxd pin 3
 RXD PIN 3 - txd pin 2
 CTS PIN 5 - rts pin 4 (Radio keying circuit/PTT)
 DSR PIN 6 - dtr pin 20 (depending on Modem)
 GND PIN 7 - gnd pin 7 (Optional)
 SEL PIN 23 - dcd pin 8 (Tie Modem DCD to sio dcdb)

Wiring two TNCs for Back-to-Back Operation

CAPS mean this TNC, lower means the other TNC

GND PIN 1 — gnd pin 1
 TXD PIN 2 ---- rxd pin 3
 RXD PIN 3 ----- txd pin 2
 CTS PIN 5 ---- sel pin 23
 GND PIN 7 ---- gnd pin 7 (Optional)
 DTR PIN 20 -- LO PIN 10
 SEL PIN 23 ----- cts pin 5

Wiring many TNCs for Back-to-Back Operation

There have been a number of methods attempted for connecting a collection of switches back to back. The most reliable is a board that contains RS-232 drivers and receivers with some simple TTL logic. A schematic for a four port board is available

from the author. An eight port board can also be done by changing the 4 input AND gate (74HC21) to an 8 input device.

The future developments planned

There a number of new features planned for the coming year, these include additional **loadable** applications and some changes to the basic switch kernel (EPROM).

The items with the highest priority are moving the routing table into battery backed up RAM and password protection of the LOADER application. Additional information to aid in evaluation of network performance needs to be collected, items such as: Frame and Packet level statistics, call detail records and automated error reporting. The call detail records will contain information such as: call duration, bytes sent, bytes received, source and destination and the clearing cause.

The targeted applications will primarily be for additional user and management features. These include: Heard Logs, Monitoring remote ports, Reliable Information Broadcast, Round Tables, controlled Beacons such as CQ and other tools for message forwarding. Any suggestions are welcome!

The ROSE X.25 Packet Switch will soon be operational in a wider range of hardware models. At that point there will be a program that will allow linking of a Switch for a specific TNC, as part of this linking process applications can be specified for inclusion in the EPROM. This will allow elimination of needless features for the specific switch. A backbone switch does not need the Level 2 User access interface or the information text connect message.

Conclusion

The ROSE X.25 Packet Switch is the most advanced packet switch for amateur packet networking. The growing collection of features and use of state of the art protocols enable it to play a key role in the growing Global Amateur Packet Network.

This is just the first tool for the RATS Open System Environment. Other projects have been identified and will be supported by or supportive of the ROSE X.25 Packet Switch. The Radio Amateur Telecommunications Society is committed to development of state of the art networking for the amateur service.

Appendix 1 - Network Configuration Example

THIS DNIC 3100 United States of America

THIS NODE Clifton
ADDRESS 201478
CALL W2VY-3
DIG1 W2VY-2
COVERAGE
201472 201473 201777 201779 201470 201478
201778 201772
END

USERPORT 0
TEXT

\$

While Disconnected From THIS X.25 Switch issue a command like:

\$

C CALLSIGN-SSID V W2VY-3,201256

\$

Switches Available for User Access are:

Address	Callsign	Location	User Port Freq
201256	W2VY-3	Montclair	221.11 M hz
201744	N2DSY-3	LittleFalls,NJ	145.07 Mhz
609426	KA2VLP-3	Hightstown,NJ	145.07 Mhz
609261	WA3YRI-3	MtHolly,NJ	145.07 Mhz
212456	KD6TH-6	Manhattan,NY	145.07 Mhz
609530	N2EVW-9	Ewing,NJ	221.01 Mhz
609883	N2EVW-8	Trenton,NJ	221.11 Mhz
201663	N2ELC-3	Lake Hopatcong,NJ	145.09 M hz

\$

Possible connect paths available to access BBS User ports.

C KB1BD-4 v W2VY-3,609426

C WA2VXT-4 v W2VY-3,609426

C KD6TH-4 v W2VY-3,201744

C N2ELC-4 v W2VY-3,201663

\$

Connect Paths Available to KA-Nodes or NETROM Facilities:

C WB2DRD-3 v W2VY-3,609426

C WB2MNF-3 v W2VY-3,609530

\$

When connecting to TheNet Nodes act as if you have connected direct to it. Type C NODENAME, after you have connected to either of the TheNet nodes listed above, to connect to the next desired node. Type NODES to get a node list after your connect or type Info to get information about the particular TheNet node you are connected to. Example: To connect to ELK TheNet node use the following sequence:

C WB2DRD-3 v W2VY-3,609530

C ELK

\$

You will shortly be Disconnected from this switch. If you are currently connected via either TheNET or KA-Node RECONNECT to THAT node and then issue a connect as shown above. Note: It has come to our attention that those systems using; old TNC1 code will not accept all digit fields, substitute o for 0 and i for 1 in the all digit field and you will be successful. Disconnect codes can be found on the KB1BD-4 PBBS, filename is DISCO.COD. Please address questions to KB1BD@KB1BD or W2VY@KD6TH. This switch brought to you courtesy of RATS. Enjoy 73 Tom W2VY

\$EOF
END

NODE Manhattan
ADDRESS 212456
PATH KD6TH-3
END

NODE LittleFalls
ADDRESS 201744
PATH N2DSY-3
END

NODE Clif ton2
ADDRESS 201779
PATH W2VY-9
PORT 1
END

NODE Montclair
ADDRESS 201256
PATH W2VY-12 Via KB1BD-2
END

USER KD6THbbs
PATH KD6TH-4
PORT 1
MAXVC 0
END

Route to Nodes Manhattan **LittleFalls**
Calls for
207 802 617 508 413 203 401
518 607 212 718 716 516 914 315
end

Route to Node Manhattan
Calls for
212456
end

Route to Node **LittleFalls**
Calls for
201744
end

Route to Node **LittleFalls**
Calls for
609 215 717 202
end
WRITE w2vy-3.t bl
QUIT